NASA SBIR/STTR Technologies

Proposal No. - Rip-Stop Reinforced Thin Film Sun Shield Structure

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Identification and Significance of Innovation

Future NASA telescope missions such as WFIRST, TPF and TPI need very large, very lightweight reflective membranes to provide for both sunshades and large coronographs. Very thin material punctures easily and, once punctured, tears propagate rapidly. Physical Sciences Inc. (PSI) has teamed again with NeXolve Corporation to fabricate production scale equipment for the deposition of electrospun nanofiber RipStop reinforcement onto CP1 thin polymer film membranes.

Expected TRL Range at the end of Contract - 6

Sequence of optical images showing the progression of a membrane tear up to a RipStop line. The images show vertically loaded 5 micron thick CP1 film with 4 mm wide RipStop reinforcement stopping tear progression. Load is transferred to the RipStop line.

Technical Objectives and Work Plan

- Fabricate electrospinning system for continuous deposition of nanofiber RipStop. Target 60” width web and 10 m/min line speed.
- Design system to operate at a range of line speeds and deposition patterns, including tunable RipStop tough ness and elasticity.
- Develop stable electrospinning operating points for a series of film products and RipStop parameters (width, density, pattern).
- Deliver system that provides 15 micron film tear and durability performance at a 5 micron film mass.
- Develop FEA design model in concert with e-spun RipStop.
- Advance tear resistance and toughness testing methods to provide more reliable prediction of long term tear propagation.
- Develop surface metrology to monitor RipStop reinforced membrane dynamics.
- Identify end users for space durable polymer membranes with strict mass requirements.

NASA and Non-NASA Applications

RipStop Reinforced thin films are used for large deployable structures such as solar sails for photon propulsion, sunshades for passive thermal control and as planet finding external occulters. The addition of nanofiber based RipStop reinforcement to a film will enhance its toughness and elasticity and improve tear resistance and tensile strength. Non-NASA uses of membrane technology include tougher separator membranes for batteries and stronger filters made of nanofibers, such as HEPA filters, with high mechanical strength and lower pressure drop under purification membranes.

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